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(71)Applicant : NIKON CORP

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(72)Inventor : TAKI KAZUYA

MIYAZAKI KEN

MIURA YOSHIHIRO

(54) REFLECTION PREVENTIVE PLASTIC LENS

(57)Abstract:

PURPOSE: To make thin and light in weight and to attain excellent transparency, resistance to scuffing and wear, adhesion property and reflection preventive property by applying an organic silicon based coating on an urethane vinyl based plastic and an anti-reflection coating consisting of the oxides of titanium and silicon thereon.



CONSTITUTION: This reflection preventive plastic lens is constituted of a plastic lens, which is made of a radical polymer of an aromatic compound expressed by formula I and an isocyanate compound, an organic silicon based coating film, which is provided on the surface of the plastic lens and is composed of a hardened film formed out of an organic silicon compound expressed by



formula 11 or the hydrolyzed product and a colloiddally dispersed antimony pentoxide sol, antimony trioxide sol or the like, and a multilayered anti-reflection layer, which is provided on the coating film and contains the oxides of titanium and/or silicon. In formula I, X expressed-H or the like. In formula II, R1 expresses 4-14C organic group, R2 expresses 1-6C hydrocarbon

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DETAILED DESCRIPTION

[Detailed Description of the Invention]

[0001]

[Industrial Application] This invention relates to an acid resistibility plastic lens. further -- detailed -- this invention -- a thin shape -- it is lightweight and is related with the new plastic lens which has the outstanding transparency and outstanding abrasion-proof nature, adhesion, and an acid-resisting property

[0002]

[Description of the Prior Art] In recent years, instead of conventional glass, plastics has come to be used as a lens material. Especially the inclination has a remarkable thing as a lens material for spectacles. However, faults, such as un-10 etc. minutes etc., have the thermal resistance a degree of hardness is inadequate and it is tended to invade the solvent which a blemish tends to attach while a plastic-lens moldings has the advantages, such as lightweight, *****, and shock resistance, and which adsorbs dust that it is easy to be charged. Conventionally moreover, the lens for the spectacles made from plastics The lens currently manufactured when most carried out the casting polymerization of a monomer called allyl-compound diethylene glycol carbonate (it omits Following ADC) In the case of the lens for myopia, since the refractive index was about 1.50 and was low compared with the refractive index about 1.52-1.80 of a glass lens, marginal thickness became thick, and with the lens for presbyopias, there is a fault that a core becomes thick and it had become the main factor disliked by the wearing person.

[0003] Then, development of the monomer for the plastic lens which has a refractive index higher than ADC was furthered, for example, various kinds of things, such as a thing JP,55-13747,A, JP,56-166214,A, JP,57-23611,A, and given in JP,57-54901,A, were proposed. The constituent for high refractive-index lenses proposed by JP,5-287049,A is also one of them. The lens of the urethane vinyl system proposed here has a high refractive index, has the outstanding transparency, a dye affinity, and shock resistance, and is put in practical use as a plastic lens for spectacles.

[0004] However, there was a problem in abrasion-proof nature as well as the plastic lens of others [lens / of an urethane vinyl system]. Moreover, in order to improve the abrasion-proof nature which the device for the property improvement of a plastic lens was advanced, for example, had become a problem in common about the conventional plastic lens on the other hand including the lens of an urethane vinyl system The proposal of "the coating constituent which makes a principal component an organic silicon compound or its hydrolyzate" (for example, refer to JP,52-11261,A), Or the proposal of what added the silica sol distributed to "an organic silicon compound or its hydrolyzate" at colloid (for example, refer to JP,53-111336,A) is made, and these proposals are put in practical use as a glasses lens.

[0005] and -- as the multilayer acid-resisting coat in a plastic lens -- SiO₂ aluminum 2O₃ adding -- ZrO₂ Or TiO₂ The proposal (JP,52-156643,A) of multilayer coating to be used, and Ta 2O₅ ZrO₂ The proposal (JP,55-22704,A) included as a high refractive-index component, and SiO₂ or SiO -- adding -- Ta 2O₅ It is, even if the proposal (JP,60-225101,A) to be used is made.

[0006]

[Problem(s) to be Solved by the Invention] it is in the situation of the Prior art as above, and the aforementioned urethane vinyl system lens attracts attention as what has a high refractive index, although it is one which is a thing This urethane vinyl system lens is conversely compared with the lens of the conventional ADC resin. since the refractive index is high For example, when coating which added the silica sol to an aforementioned organic silicon compound or an aforementioned organic silicon compound was applied, the interference fringe was visible to the paint film, and there was a trouble that the appearance of a lens was bad.

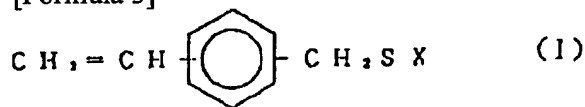
[0007] Moreover, these coating also affected the multilayer acid-resisting coat which consists of an inorganic oxide formed on the paint film, and had the trouble that an acid-resisting coat could not demonstrate the performance as a design, or produced variation. And there was a trouble of being hard to give low highly efficient coating of a reflection factor in an acid-resisting coat, for this trouble.

[0008] Then, this invention cancels the conventional trouble about the lens which consists of thin and lightweight high refractive-index plastics which used urethane vinyl resin, and its interference fringe is not visible to a paint film, and neither nonuniformity nor BATATSUKI is in a reflected color, it has the highly efficient acid-resisting coat where a reflection factor is low, and aims at offering a new plastic lens. Moreover, this invention aims at offering the new plastic lens excellent in transparency, abrasion-proof nature, surface hardness, abrasion resistance, flexibility, antistatic nature, thermal resistance, water resistance, chemical resistance, etc.

[0009]

[Means for Solving the Problem] As that <A> to which this invention solves the aforementioned trouble The plastic lens which consists of a radical polymerization object of the aromatic compound and iso thio cyanate compound which are expressed with a general formula (I), and [0010]

[Formula 3]



[0011] (The inside of a formula and X show -H, -ROH, or -RSH, R is expressed with C_nH_{2n} and n is the hydrocarbon group of 1-4)

 (a) general formula prepared in the front face of the aforementioned plastic lens (II) : [0012]

[Formula 4]



[0013] They are the organic silicon compound expressed with (R1 is the organic machine of the carbon numbers 4-14 which have functional-group or unsaturation double combination among a formula, R2 is the hydrocarbon group or halogenated-hydrocarbon machine of carbon numbers 1-6, R3 is the alkyl group, alkoxyalkyl group, or acyl group of carbon numbers 1-4, and a and b are 0 or 1, respectively, and a+b is 1 or 2), or its hydrolyzate.;

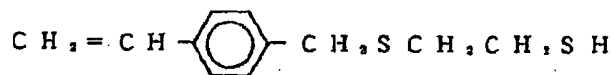
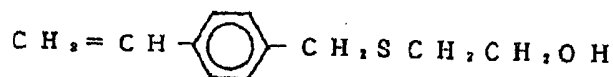
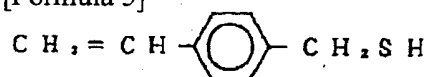
(b) The antimony pentoxide sol, antimony-trioxide sol which were distributed to colloid, A zirconium-oxide sol, a titanium oxide sol, a tin-oxide sol, a tungstic-oxide sol, An aluminum-oxide sol, titanium oxide, the compound sol of a cerium oxide, the compound sol of titanium oxide and iron, The organic silicon system coating film of the tin oxide, the compound sol of a tungstic oxide and the tin oxide, and at least one or more sorts of sol; of the sol which covered the tin-oxide sol with the compound sol of a tungstic oxide characterized by the bird clapper from a hardening film, <C> The acid resistibility plastic lens characterized by the bird clapper from multilayer antireflection film; containing the oxide of the titanium and/or the silicon which were prepared on the aforementioned coating film is offered.

[0014]

[Function] Although this invention offers the new acid resistibility plastic lens which consists of the above-mentioned composition, the outstanding operation is realized for the first time by use and the close indivisible combination of the characteristic element of the above <A><C>. Then, this characteristic element <A><C> is explained in detail below <A>. Although the polymer of the

aromatic sulfur-containing compound and iso thio cyanate compound which are expressed with a formula (I) is used as a plastic-lens main part in invention of polymer plastic-lens ** as aforementioned, as the example, it is [0015] in this case, for example.

[Formula 5]



[0016] And the metaisomerism objects of these compounds, those mixture, etc. can be mentioned. Of course, it is not limited to these. Moreover, as an example of an iso thio cyanate compound, although xylylene diisothiocyanate, a BISUIISO thio cyanate methylcyclohexane, BISUIISO thio cyanate methylthiophene, a BISUIISOCHIO cyanate MECHIRUTETORAHIFORO thiophene, a BISUIISO thio cyanate cyclohexane, toluylene diisothiocyanate, hexamethylene diisothiocyanate or those chlorination objects, a bromination object, etc. can be mentioned, it is not limited to these. As a desirable thing of these iso thio cyanate compounds, they are xylylene diisothiocyanate and BISUIISO thio cyanate methylthiophene, for example.

[0017] As for the ratio of the aromatic sulfur-containing compound and iso thio cyanate compound which are expressed with the aforementioned formula (I) for constituting the plastic lens of this invention, it is desirable that the ratio of the total number of mols of OH basis of an aromatic sulfur-containing compound or a sulfhydryl group and the total number of mols of an iso thio cyanate machine is 0.5 or more and 2 or less range. The ratios of the total number of mols are 0.7 or more and 1.5 or less more preferably. When [this] out of range, the thermal resistance of the hardened material obtained, intensity, etc. tend to be insufficient.

[0018] A radical polymerization initiator, and reactivity and the diluent of non-reactivity are used for manufacture of the radical polymerization object of the aromatic sulfur-containing compound of a formula (I) and iso thio cyanate compound which constitute a plastic lens. Furthermore, additives, such as an antioxidant and an ultraviolet ray absorbent, are added to a polymer. Well-known photopolymerization catalysts, such as various kinds of thermal polymerization catalysts, such as a benzoyl peroxide and an azobisisobutyronitril, including a well-known thing, a benzophenone, and a benzoyl, are mentioned that the radical polymerization initiator said here should just be what generates a radical by heating or ultraviolet rays, or the electron ray.

[0019] although the loadings of these radical polymerization initiators do not generally have ***** since they change with the components and the hardening methods of a polymerization constituent -- usually -- constituent ***** -- receiving -- 0.01wt(s)% - 5.0wt% -- it is the range of 0.1wt(s)% - 2.0wt% preferably Moreover, you may carry out minute amount addition of the well-known catalyst component in order to fully advance the reaction of an iso thio cyanate compound to a polymerization constituent and to raise the intensity of a hardened material, thermal resistance, etc. the tin compound and amine compound which are represented by the Djibouti rutin JIRAURI rate as this catalyst component, for example -- it is -- the addition -- usually -- a constituent total amount -- receiving -- 0.01wt(s)% - 5.0wt% -- it is the range of 0.1wt(s)% - 2.0wt% preferably

[0020] Moreover, you may dilute a polymerization constituent by the radical reactivity compound, for example, styrene, crawl styrene, divinylbenzene benzyl acrylate, hydroxyethyl methacrylate, etc. It is possible to raise more the practicality of the resin which adds additives, such as a still better known antioxidant to a polymerization constituent and an ultraviolet ray absorbent, and is obtained. Moreover, it is possible to add a well-known release agent and to also make the mold-release characteristic of the

resin obtained improve.

[0021] In this invention, polymerization hardening will usually be carried out as follows, and a lens will be manufactured. That is, after pouring a polymerization constituent into the mold made from a glass metallurgy group and advancing a polymerization hardening reaction by heating and/or ultraviolet rays, or electron beam irradiation, it removes from a mold. The setting time is usually 12 - 48 hours for 0.1 to 100 hours, and 10-140 degrees C of curing temperatures are usually 20-120 degrees C.

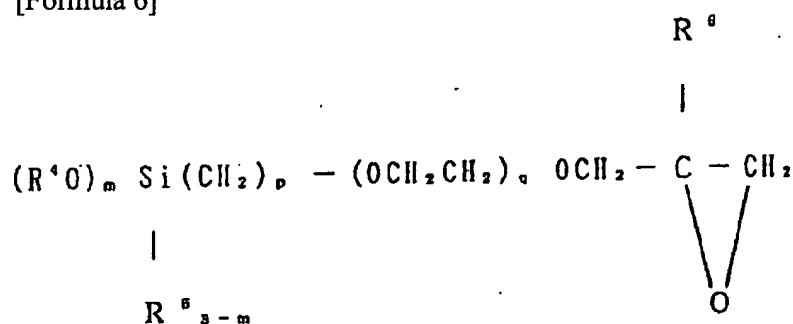
[0022] Thus, the lens obtained has a high refractive index compared with a well-known lens, and, moreover, does not have polymerization distortion or forming distortion.

 About the compound of a general formula (II) used as a (a) component of the organic silicon system coating film above, it is the R1. Although it is the organic machine with various kinds of functional groups or unsaturation double combination of carbon numbers 4-14 As the typical thing, in this case, an epoxy group, a hydroxyl, An ether machine, an alkoxy group, a vinyl group, an allyl group, a carbonyl group, a carboxyl group, an asylum machine, an acyloxy machine, an ester machine, a cyano group, the amino group, a halogen machine, a sulfhydryl group, a thioether machine, a glare machine, a carver mate machine, an amide group, etc. are illustrated.

[0023] R1 In the case where it is the epoxy group of a functional group, the following are used, for example.

General formula (III) : [0024]

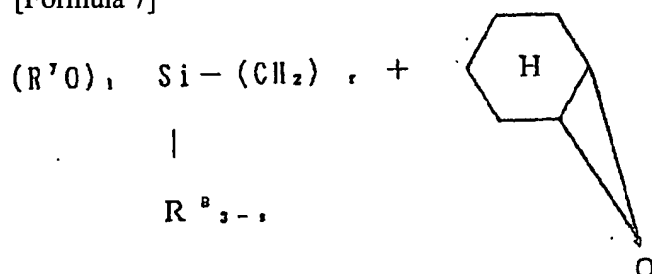
[Formula 6]



[0025] (-- for the hydrocarbon group of carbon numbers 1-6 or a halogenated hydrocarbon, and R6, hydrogen or a methyl group, and m are [R4 / the alkyl group of carbon numbers 1-4, an alkoxyalkyl group or an acyl group, and R5 / 1-6q of 2 or 3p] 0-2 among a formula Compound expressed with).

General formula (IV) [0026]

[Formula 7]



[0027] For (R7, the alkyl group of carbon numbers 1-4, an alkoxyalkyl group or an acyl group, and R8 is [2 or 3r of the hydrocarbon group of carbon numbers 1-4 or a halocarbon-ized hydrogen machine, and s] 1-4. Compound expressed with). The above-mentioned general formula (III) Since each compound expressed with (IV) has an epoxy group, it is also called epoxy silane.

[0028] As an example of these epoxy silanes, gamma-glycidoxypropyltrimetoxysilane, gamma-glycidoxy propyltriethoxysilane, gamma-glycidoxy PUROPIRUTORI methoxyethoxy silane, gamma-glycidoxy propyl triacetoxysilane, gamma-glycidoxy propyl methyl dimethoxysilane, gamma-

glycidoxypropylmethyldietoxysilane, beta-(3, 4-epoxycyclohexyl) ethyltriethoxysilane, etc. are mentioned, for example.

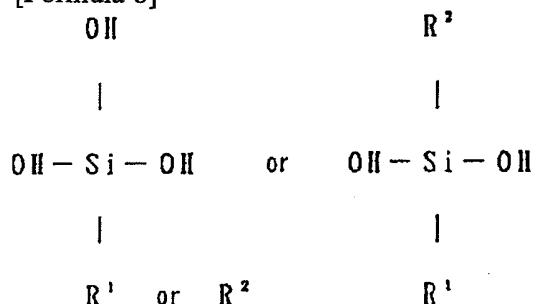
[0029] moreover, the compound of the aforementioned general formula (II) -- obtaining -- R1 As examples other than what has an epoxy group as a functional group (the thing of a= 0 is included), the following compound is mentioned, for example. Methyl trimetoxysilane, methyl triethoxysilane, vinyltrimetoxysilane, Vinyltriethoxysilane, vinyltriacetoxysilane, a vinyl trimethoxy ethoxy silane, Gamma-methacryloxypropyl trimethoxy silane, aminomethyl trimethoxysilane, 3-aminopropyl trimethoxysilane, 3-aminopropyl triethoxysilane, Phenyl trimethoxysilane, phenyl triethoxysilane, gamma-chloropropyltrimetoxysilane, Various trialkoxysilane, such as gamma-mercapto propyl triethoxysilane, 3 and 3, and 3-trifluoropropyl trimetoxysilane, thoria siloxysilane, or a thoria RUKOKISHI alkoxysilane compound.

[0030] Each instantiation compound of the general formula (II) held above is OR3 combined with Si atom. It is OR3 although it is the example of three organic functions with three machines (a+b=1)., of course, the compound with which two organic functions with two machines (a+b=2) correspond can also be used. As an example of the compound with which two organic functions correspond, there are dimethyl dimethoxysilane, diphenyl dimethoxysilane, methylphenyl dimethoxysilane, methyl vinyl dimethoxysilane, dimethyl diethoxysilane, etc.

[0031] And although the compound of a general formula (II) may be used by one sort, two or more sorts may be mixed and used for it according to the purpose. When using the compound of two organic functions especially, it is desirable to use together with the compound of three organic functions. When it uses together, it is set to $2 > a+b > 1$ on an average. Furthermore, it is also possible to use together the compound with which four organic functions of a+b=0 correspond. As an example of the compound with which four organic functions correspond, a methyl silicate, an ethyl silicate, an isopropyl silicate, n-propyl silicate, n-butyl silicate, t-butyl silicate, a sec-butyl silicate, etc. are mentioned.

[0032] Although the compound of a general formula (II) may be used as it is, it is desirable to use it as a hydrolyzate in order to lower the increase of a reaction rate and a curing temperature. When using two or more sorts together, the compound of the number of organic functions which is different in the compound of the number of the same organic functions in the compound of two to 4 organic functions when using two or more sorts together may be used together after hydrolysis, and may be used together before hydrolysis, and you may perform a cohydrolysis. It is silanol: [0033] to which alcohol separates and the compound of a general formula (II) is equivalent.

[Formula 8]



[0034] It comes to be alike. Dehydration condensation progresses promptly and a silanol becomes oligomer. Therefore, you may carry out neglect (care of health) after hydrolysis for 1 to 24 hours so that this reaction may fully progress. The sol used as the aforementioned (b) component is as aforementioned at least one sort of sol ** which covered the tin oxide sol with the compound sol of the antimony pentoxide sol distributed to colloid, an antimony-trioxide sol, a zirconium-oxide sol, a titanium oxide sol, a tin oxide sol, a tantalum oxide sol, a tungstic-oxide sol, an aluminum-oxide sol, titanium oxide, the compound sol of a cerium oxide and titanium oxide, and iron, tin oxide, the compound sol of a tungstic oxide and tin oxide, and the compound sol of a tungstic oxide.

[0035] the particle diameter of the sol in this case -- 1-200 -- the thing of 5-100mmicro is especially

desirable in micro. When smaller than this, manufacture is difficult, and own stability of a sol also has it, and the effect of manufacture is also small. [bad] On the other hand, if larger than this, the stability of a coating constituent, the transparency of a paint film, smooth nature, etc. will fall. These sols are respectively well-known and available as commercial elegance in part.

[0036] A sol is the colloidal solution which water, the organic solvent, or both mixed solvent was made to distribute, and it can be made to be able to stabilize using various organic acids in added and stabilizing suitable alkali, especially an organic amine ****, or it can use what was stabilized with the surfactant. Especially the sol that covered the tin oxide sol with the compound sol of an antimony pentoxide sol, an antimony-trioxide sol, an oxidation zirconia sol, a titanium oxide sol, a tin oxide sol, a tantalum oxide sol, a tungstic-oxide sol, titanium oxide, the compound sol of a cerium oxide and titanium oxide, and iron, tin oxide, the compound sol of a tungstic oxide and tin oxide, and the compound sol of a tungstic oxide has a highly desirable refractive index. Even if it uses independently, you may use these sols as two or more kinds of mixture.

[0037] By the ability blending the oxidation catalyst for formation of the hardening film using these sols, when carrying out the polymerization of the diameter compound of organic silicon (aforementioned [a]), or its hydrolyzate and making the paint film of the 3-dimensional network structure form, in order for this thing to shorten time, it is used if needed, and the following is used (however, what spoils the stability of a coating constituent is not desirable).

<1> Amines; a monoethanolamine, a diethanolamine, an isopropanolamine, ethylenediamine, an isopropylamine, diisopropylamine, a morpholine, a triethanolamine, diaminopropane, aminoethylethanolamine, a dicyandiamide, a triethylenediamine, 2-ethyl-4-methyl imidazole.

<2> various metal complex-compound: -- general formula: -- aluminum chelate compound shown by $AlX_n Y_{3-n}$ (however, it is at least one chosen from the ligand to which X originates in OL (L is a low-grade alkyl group) among a formula, and Y originates in general formula $M_1 COCH_2 COM_2$ and (M_1 and M_2 are a low-grade alkyl group) $M_1 COCH_2 COOM_2$, and n is 0, 1, or 2)

[0038] As an especially useful chelate compound, they are the aluminum acetylacetonate from a viewpoint of solubility, stability, and the catalyst effect, aluminum bis-ethylacetoacetate, monoacetyl acetonate, aluminum di-n-butoxidemonoethylacetoacetate, aluminum-G iso-propoxide mono methyl acetoacetate, etc.

[0039] The chromium acetylacetonate outside it, titanyl acetylacetonate, cobalt acetylacetonate, iron (3) acetylacetonate, manganese acetylacetonate, nickel acetylacetonate. As other metal complex compounds, it is the ethylenediaminetetraacetic acid metal salt compound shown by general formula: $M(CH_2 N(CH_2 COO)_2)_2 Na_x$ (X=1-3).

[0040] Especially useful compounds are ethylenediaminetetraacetic acid calcium, ethylenediaminetetraacetic acid magnesium, ethylenediaminetetraacetic acid aluminum, ethylenediaminetetraacetic acid manganese, ethylenediaminetetraacetic acid copper, ethylenediaminetetraacetic acid zinc, ethylenediaminetetraacetic acid iron, ethylenediaminetetraacetic acid cobalt, and an ethylenediaminetetraacetic acid bismuth.

<3> Metal alkoxide: Aluminum NIUMUTORI ethoxide, aluminum NIUMUTORI n-propoxide, aluminum NIUMUTORI n-butoxide, tetrapod ETOKI titanium, tetra-n-butoxytitanium, tetrapod i-propoxytitanium.

<4> Organic-metal salt: Sodium acetate, a zinc naphthenate, naphthenic-acid cobalt, octylic acid zinc, octylic acid tin.

<5> Perchlorate: A magnesium perchlorate, ammonium perchlorate.

<6> An organic acid or its anhydride: A malonic acid, a succinic acid, a tartaric acid, an adipic acid, an azelaic acid, a maleic acid, O-phthalic acid, a tele free-wheel-plate acid, a fumaric acid, an itaconic acid, oxaloacetic acid, a succinic anhydride, a maleic anhydride, itaconic acid anhydride, 1, 2-dimethyl maleic-acid anhydride, phthalic anhydride, a hexahydrophthalic acid anhydride, anhydrous naphthalic acid.

<7> Lewis acid: A ferric chloride, aluminum chloride.

<8> halogenation metal: -- a stannous chloride, a stannic chloride, and bromination -- tin, a zinc

chloride, a zinc bromide, a titanium tetrachloride, and bromination -- titanium and bromination -- a thallium, chlorination germanium, a chlorination hafnium, a lead chloride, and lead bromide

[0041] Two or more sorts may use the above catalyst, mixing, without using it independently. When the organic silicon compound of the aforementioned (a) component or its hydrolyzate has an epoxy group especially, you may use what serves as the ring-opening-polymerization catalyst of an epoxy group. An aluminum chelate compound is especially one of the desirable catalysts. A solvent may be used, and this thing is used for the aforementioned constituent for hardening film generation if needed, in order to make a coating constituent liquefied, or in order to make viscosity low. For example, water, a lower alcohol, an acetone, the ether, a ketone, ester, etc. are used.

[0042] and a coating constituent -- setting -- the 100 weight sections (solid content) of (a) organic silicon system compound or its hydrolyzate -- hitting -- (b) sol component -- the 10 - 400 weight section (solid content) -- it is appropriate to carry out 50-250 weight section (solid content) use preferably, and for the (a) component and the (b) component to hit a total of 100 weights sections (solid content), and to carry out 0.00001-20 weight section use of the aforementioned catalyst component

[0043] About a solvent, suitable amount use is carried out according to the viscosity of a constituent. Furthermore, if needed, you may use various additives together in order to raise the stability of a coating constituent for the purpose of an adhesive improvement with the base material (moldings) of the side applied, weatherproof improvement, etc. As an example of an additive, there are a pH regulator, a viscosity modifier, a leveling agent, a delustering agent, a color, a pigment, a stabilizer, an ultraviolet ray absorbent, an antioxidant, etc.

[0044] Outside it, you may use together the organic polymer of an epoxy resin and others in order to raise the flexibility of a paint film. There is a methyl methacrylate copolymer etc. about the epoxy novolak which consists of cycloaliphatic epoxy resins, such as polyolefine system epoxy currently used widely a paint and for notes forms, a cyclopentadiene oxide, and a cyclohexene oxide or poly glycidyl ester, poly glycidyl ether, epoxidation vegetable oil, novolak type phenol resin, and epichlorohydrin as an epoxy resin, and also glycidyl meta-KURITORE.

[0045] As other organic polymer, there are a polyol, a fibrin system resin, melamine resin, etc., for example. It is the purpose for which the flow at the time of an application is raised, the smooth nature of a paint film is raised, and coefficient of friction on the front face of a paint film is reduced, and it is also possible to use various kinds of surfactants together to a coating constituent, and especially a block or graft copolymer of dimethylsiloxane and an alkylene oxide, and a further have an effective fluorochemical surfactant etc.

[0046] The glasses lens as an urethane vinyl system lens gets damaged, and especially coating film of this invention as above is useful as a prevention film. The usual painting methods, such as brush coating, being immersed, roll coating, spray painting, and flow coating, can be used for an application means. Furthermore, after applying the constituent for the above-mentioned coating of this invention to mold, after [used as the base-material moldings <aforementioned / A />] carrying out a raw material notes type polymerization, fabricating a plastic-molding object or applying the constituent of this invention to a moldings, the paint film front face which has not yet been hardened can be stuck with mold, and a paint film can also be stiffened on it.

[0047] After applying the constituent for coating, in many cases, it is stiffened by heat-treating and obtains a hard paint film. Paint film temperature is about 50-200 degrees C. Desirable effect sufficient at 80-140 degrees C is acquired. Generally it is after dryness, and if there is 0.3-30micro of thickness of a paint film also 0.5-10micro preferably, it is enough.

[0048] A paint film is transparent, is excellent in a degree of hardness, especially scratch-proof nature, does not cause the fall of the appearance scratch and according to a blemish which was the trouble of a plastic-molding object, and can offer a remarkable moldings with high goods value.

The antireflection film in invention of <C> oxide multilayer ***** carries out the laminating of a low refractive-index film and the high refractive-index film by turns, and a silicon dioxide (SiO₂) is used for it as titanium oxide (TiO₂) and a low refractive-index layer as a high refractive-index layer at this time. Counting from a substrate side, when 2λ [$\lambda/4$ - $\lambda/4$], and $\lambda/2$ -

$\lambda/4$ are desirable and they are $\lambda/4$, and $\lambda/2-\lambda/4$ composition as fundamental film composition, the film of the 1st layer is TiO_2 . SiO_2 It is good also as the used three-layer equivalent film or a two-layer composite film. Moreover, in the 1st layer, they are the quality of mixture of a zirconium oxide (ZrO_2) and an aluminum oxide (aluminum 2O_3), or oxidization plastic SEOJUMU (Pr 6011) and aluminum 2O_3 . Mixture can be used.

[0049] TiO_2 It is TiO_2 when forming membranes by the vacuum deposition method. Although self can be used as a source of vacuum evaporations, generally it is TiO_2 . There may be many gas evolutions and may lack in the stability at the time of membrane formation. In this case -- as the source of vacuum evaporations -- the low-grade oxide of titanium -- desirable -- TiO_x ($1 \leq x < 2$) -- using -- the inside of a vacuum evaporation tub -- O_2 The reactant vacuum deposition which introduces gas can be used. According to this method, it is stabilized extremely and is TiO_2 . A film can be formed.

[0050] TiO_2 Since a film has sufficient endurance and has about further 2.25 high refractive index even when it is used on a plastic-lens substrate, its design top of an antireflection film is also advantageous. That is, a reflection factor is low, a wavelength region with the acid-resisting effect can be extended, and the number of layers for acquiring the above effect can be reduced. Generally in producing the above antireflection film, a vacuum deposition method can be used, and also the sputtering method using the sintered compact of the above-mentioned matter and methods, such as the ion rating method, can be used.

[0051] giving the acid-resisting coat which performs organic silicon system coating on an urethane vinyl system plastic lens as mentioned above, and consists of an oxide of titanium and silicon -- the thin shape of this invention -- it is lightweight and the acid resistibility plastic lens which has the outstanding transparency and outstanding abrasion-proof nature, adhesion, and an acid-resisting property can be obtained Hereafter, although an example explains concretely, this invention is not restricted to the following examples.

[0052]

[Example]

The mixture 64 weight section of example 1 (creation of urethane vinyl system plastic lens) 2-(4-vinylbenzyl thio) ethanol, and 2-(3-vinylbenzyl thio) ethanol, The meta xylene diisothiocyanate 36 weight section, the par butyl ND(t-butylperoxy neodecanoate) 0.2 weight section, V-40 (the 1 and 1-azobis (cyclohexane-1-carbonitrile) 0.2 weight section --) The Djibouti rutin JIRARURI rate 0.2 weight section and the 2-(2'-hydroxy-5'-t-octyl phenyl) benzotriazol 0.2 weight section were mixed, and indirect desulfurization mind was performed for 30 minutes, cooling under the vacuum of 1×10^{-1} Torr.

[0053] Next, the mold for fabrication was created combining the glass type for lens fabrication and the glass gasket made of synthetic resin, and the aforementioned mixture was poured in. The temperature up was linearly carried out continuously over 15 hours from 30 degrees C to 110 degrees C, it held at 110 degrees C for 5 hours, and the polymerization was performed. The gasket after a polymerization end was removed and the lens removal urethane vinyl system lens was obtained from the type for lens fabrication.

[0054] The obtained lens was transparent and colorless and, moreover, its specific gravity was [a refractive index is very as high as 1.66, and] as lightweight as 1.26. Moreover, thermal resistance and shock nature are good, there is no distortion, and shock resistance, cutting ability, and polish nature were also excellent.

(Creation of an organic silicon system coating film)

1) Adjustment of a reserve constituent <M1> : the 0.05 convention hydrochloric-acid solution 36 weight section was added at once, having taught the gamma-glycidoxy-propyl-methyldimethoxysilane 248 weight section into the reaction container equipped with the rotator, and stirring violently using a magnetic stirrer.

[0055] Although it was an uneven solution immediately after addition, it became a uniform and transparent and colorless solution, generating heat in several minutes. Stirring was continued for further 1 hour and the hydrolyzate equivalent to a component (a) was obtained. After adding the ethanol 56.6 weight section and the ethylene glycol 53.4 weight section to the obtained hydrolyzate as a solvent

component, added the aluminum acetylacetonate 4.7 weight section as a catalyst component to it, it was made to fully carry out the mixed dissolution, and the reserve constituent <M1> was adjusted to it.

2) Adjustment of a reserve constituent <M2> : the 0.01 convention hydrochloric-acid solution 48.6 weight section was dropped gradually, having taught the gamma-glycidoxy propyl methoxy silane 212.4 weight section into the reaction container equipped with the rotator, having kept the temperature in a container at 10 degrees C, and stirring violently using a magnetic stirrer. After the dropping end obtained the hydrolyzate equivalent to the component (a) of the shape of a uniform and transparent and colorless solution, when cooling was stopped immediately.

[0056] After adding the ethanol 77.1 weight section and the ethylene glycol 37.7 weight section to the obtained hydrolyzate as a solvent component, added the aluminum acetylacetonate 7.65 weight section as a catalyst component to it, it was made to fully carry out the mixed dissolution, and the reserve constituent <M2> was adjusted to it.

The reserve constituent <M1> adjusted to the glassware with the above 1 and 2 Adjustment of a coating constituent : 3) 20 weight sections, Carry out weighing capacity of the 80 weight sections (it is not a solid-content rate), and <M2> is poured out. The coating constituent of the shape of a uniform and transparent and colorless solution was adjusted by carrying out 0.45 weight section addition of the 150 weight sections (it not being a solid content) and the silicone system surfactant there, and fully carrying out stirring mixture of the commercial antimony pentoxide sol to it.

4) The above-mentioned coating constituent was applied on the application aforementioned polyurethane system lens by dip coating (a part for 10cm/in pull-up speed), it heat-treated at 100 degrees C for 2 hours, and the paint film was stiffened.

(Creation of a multilayer antireflection film) The multilayer acid-resisting coat was formed by the vacuum deposition method using the commercial vacuum evaporation system. It is SiO₂ as a vacuum evaporatio no raw material of a low refractive-index film. It uses and is Ti 9O6 as a vacuum evaporatio no raw material of a high refractive-index film. It used.

[0057] The polyurethane lens which gave organic silicon system coating produced by the aforementioned method was put in in the vacuum tub, and it exhausted, heating at about 80 degrees C, and exhausted to 1x10⁵ Torr. The vacuum evaporatio no of the above-mentioned vacuum evaporatio no. raw material was carried out by the electron-beam-heating method. Ti 4O5 Oxygen gas was introduced at the time of vacuum evaporatio no, and it performed vacuum evaporatio no so that it might be set to 1x10⁻⁴Torr. It is the composition of an antireflection film to Table 1 [0058]

[Table 1]

レンズからの層数	蒸着物質	屈折率	光学膜厚
第1層	酸化チタン	2. 2 5	0. 0 4 λ
第2層	酸化ケイ素	1. 4 7	0. 1 0 λ
第3層	酸化チタン	2. 2 5	0. 5 0 λ
第4層	酸化ケイ素	1. 4 7	0. 2 4 λ

[0059] (Criticism **) The next examination was presented with the lens produced as mentioned above, and the performance was evaluated.

1. The visual judgment estimated the following item using the lighting system with an illuminance of 1000 lux which used the appearance usual white fluorescent lamp as the light source.

[0060] (1) Transparency [.. The thing evaluation with a uniform reflected color went as follows.] Homogeneity inside being [coloring or nebula] (2) lens .. Homogeneity of being [no ununiformities, such as a stria,]-in the interior of lens (3) antireflection film

O [.. The spectral reflectance which is 350nm - 800nm of 2. reflection properties with a problem was measured with the 330 type spectrophotometer by Hitachi, Ltd.] Satisfactory ** .. x which has a problem a little

3. measurement Asahi of a luminous transmittance -- a spectrum -- visibility permeability was measured using the incorporated company model 304 type visibility penetrometer

4. 100 eyes of GOBAN were made for the product[made from adhesion]-created lens by putting the 2-hour immersing back into 90-degree C hot water, and putting a cut line into a paint film side every other mm with a knife at a lengthwise longitudinal direction, and cellophane adhesive-tape (goods) name "Scotch tape" Nichiban Co., Ltd. make was stuck strongly after that. It had the end of a tape in the hand, stripped quickly in the direction 90 degrees, and investigated how many eyes of GOBAN of a paint film separate. Several X is used as the molecule of the eye of GOBAN which separated, and it expresses with X/100. Adhesion is so good that X is small.

5. -proof -- the lens front face was rubbed by abrasion nature examination steel wool #0000, and the difficulty of getting damaged was investigated In addition, evaluation carried out as follows.

[0061] O Even if it rubs strongly, a blemish does not stick.

O If it rubs quite strongly, a blemish will attach a few.

** A blemish also attaches weak friction.

Evaluation of a lens without a paint film incidentally was x. The above evaluation result was shown in drawing 1 and the after-mentioned table 6.

The same urethane vinyl system lens as example 2 example 1 was prepared, it replaced with the antimony pentoxide sol of the coating constituent of an example 1, and the organic silicon system coating film was given by the same method as an example 1 using titanium oxide and the compound sol of a cerium oxide.

[0062] The multilayer antireflection film of the composition of Table 2 was created by the vacuum deposition method same on the aforementioned organic silicon coating film as an example 1.

[0063]

[Table 2]

レンズからの層数	蒸着物質	屈折率	光学膜厚
第1層	酸化チタン	2. 2 5	0. 5 0 λ
第2層	酸化ケイ素	1. 4 7	0. 2 5 λ

[0064] The evaluation result was shown in drawing 2 and Table 6.

The same urethane vinyl system lens as example 3 example 1 was prepared, it replaced with the antimony pentoxide sol of the coating constituent of an example 1, and the organic silicon system coating film was given by the same method as an example 1 using the compound sol of titanium oxide and iron.

[0065] The multilayer antireflection film of the composition of Table 3 was created by the vacuum deposition method same on the aforementioned organic silicon coating film as an example 1.

[0066]

[Table 3]

レンズからの層数	蒸着物質	屈折率	光学膜厚
第1層	Z + A あるいは P + A	1. 7 2	0. 2 5 λ
第2層	酸化チタン	2. 2 5	0. 5 0 λ
第3層	酸化ケイ素	1. 4 7	0. 2 5 λ

[0067] Here, Z+A shows the quality of mixture of a zirconium oxide and an aluminum oxide. P+A shows the quality of mixture of oxidation plastic SEOJIUMU and an aluminum oxide. The evaluation result was shown in drawing 3 and Table 6.

The same urethane vinyl system lens as example 4 example 1 was prepared, it replaced with the antimony pentoxide sol of the coating constituent of an example 1, and the organic silicon system coating film was given by the same method as an example 1 using the sol which covered the tin oxide sol using titanium oxide and the compound sol of a tungstic oxide.

[0068] The multilayer antireflection film of the composition of Table 4 was created by the vacuum deposition method same on the aforementioned organic silicon coating film as an example 1.

[0069]

[Table 4]

レンズからの層数	蒸着物質	屈折率	光学膜厚
第1層	酸化ケイ素	1. 4 7	0. 0 7 λ
第2層	酸化チタン	2. 2 5	0. 0 6 λ
第3層	酸化ケイ素	1. 4 7	0. 1 1 λ
第4層	酸化チタン	2. 2 5	0. 5 0 λ
第5層	酸化ケイ素	1. 4 7	0. 2 4 λ

[0070] The evaluation result was shown in drawing 4 and Table 6.

It created by the same method as example of comparison 1 (creation of a plastic lens) example 1.

(Creation of an organic silicon system coating film) It replaced with the antimony pentoxide sol of the coating constituent of an example 1, and the silicon-dioxide sol was used, the coating constituent was created and applied, and the organic silicon system coating film was created.

(Creation of a multilayer antireflection film) By the vacuum deposition method, the multilayer antireflection film of the composition of Table 5 was created on the aforementioned organic silicon system coating film.

[0071]

[Table 5]

レンズからの層数	蒸着物質	屈折率	光学膜厚
第1層	酸化ケイ素	1.47	0.06λ
第2層	酸化ジルコニウム	2.00	0.18λ
第3層	酸化ケイ素	1.47	0.06λ
第4層	酸化ジルコニウム	2.00	0.25λ
第5層	酸化ケイ素	1.47	0.25λ

[0072] The evaluation result was shown in drawing 5 and Table 6. Fine irregularity was in the acid-resisting property, and nonuniformity was remarkable to the reflected color. Moreover, they were permeability mist and an inferior thing.

The polycarbonate shaping lens was used for example of comparison 2 plastic lens, and the same organic silicon system coating film as an example 1 and the multilayer antireflection film were created.

[0073] Although the evaluation result was almost the same as drawing 1, it was a thing inferior to transparency, internal homogeneity, adhesion, and abrasion-proof nature as Table 6.

[0074]

[Table 6]

実施例	外 観			透 過 率	密 着 性	耐 摩 擦 性
	透明性	内部	反射色			
1	○	○	○	98.5%	0/100	○
2	○	○	○	96.0%	0/100	○
3	○	○	○	98.9%	0/100	○
4	○	○	○	98.7%	0/100	○
比較例						
1	○	○	×	95.1%	0/100	○
2	△	△	○	98.6%	8/100	△

[0075]

[Effect of the Invention] According to this invention the above passage, an acid resistibility plastic lens

with the following features is obtained.

(1) the thin shape excellent in transparency and internal homogeneity -- it is a lightweight acid-resisting plastic lens

[0076] (2) When it excels in an acid-resisting property and a surface flash uses it for a glasses lens few, eyes are the acid resistibility plastic lenses which are visible shapely.

(3) When permeability uses it for **** and a glasses lens, it is the acid resistibility plastic lens which can obtain the field of view felt refreshed.

(4) It is the acid resistibility plastic lens which does not have nonuniformity in the reflected color of an antireflection film.

[0077] (5) A highly efficient antireflection film with a low reflection factor is the acid resistibility plastic lens which can be formed by the few number of layers.

(6) It is the acid resistibility plastic lens which was excellent in abrasion-proof nature, surface hardness, and abrasion resistance, and was excellent also in the adhesion of a coating film.

(7) They are flexibility, thermal resistance, warm water-proof nature, and the acid resistibility plastic lens that was excellent chemical-resistant.

[0078] (8) It is the acid resistibility plastic lens which antistatic nature is excellent in and cannot be stained with dirt comparatively easily.

[Translation done.]

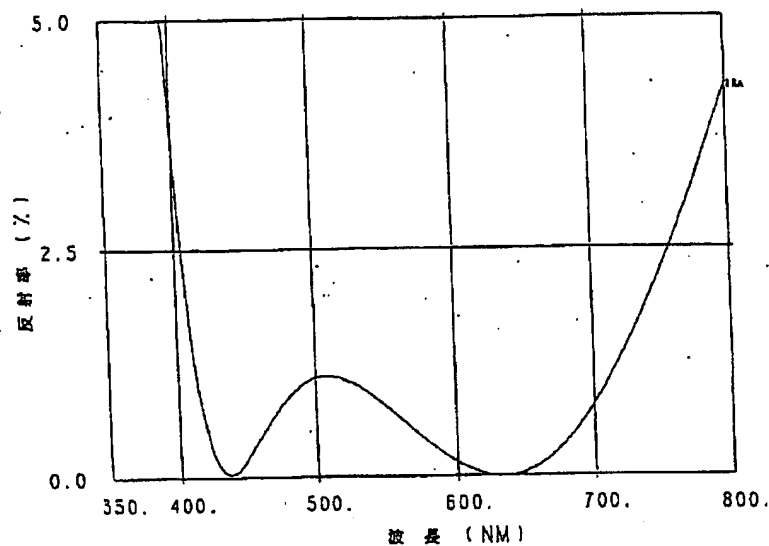
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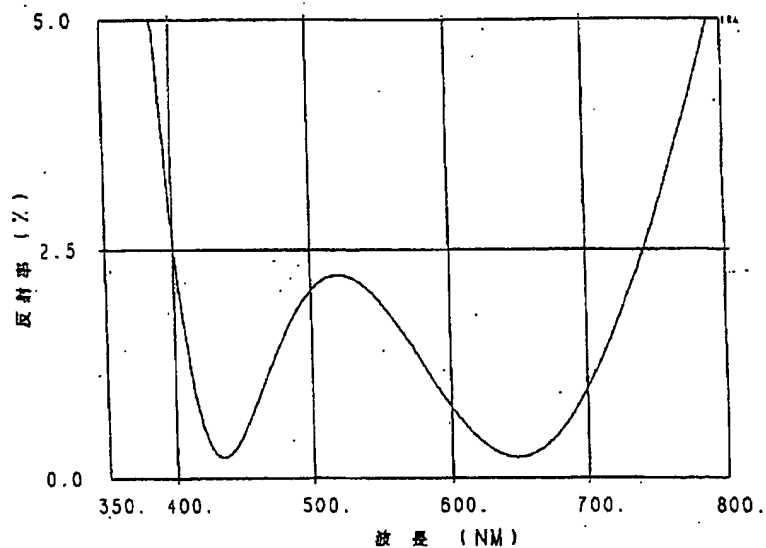
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DRAWINGS

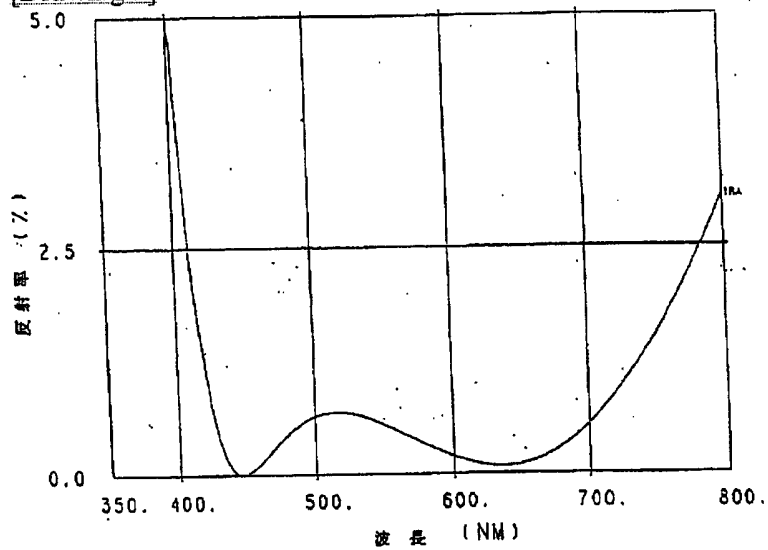
[Drawing 1]



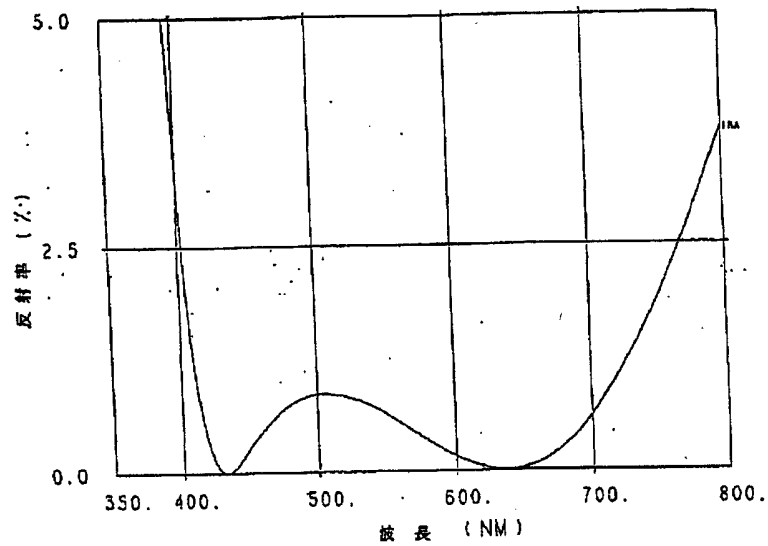
[Drawing 2]



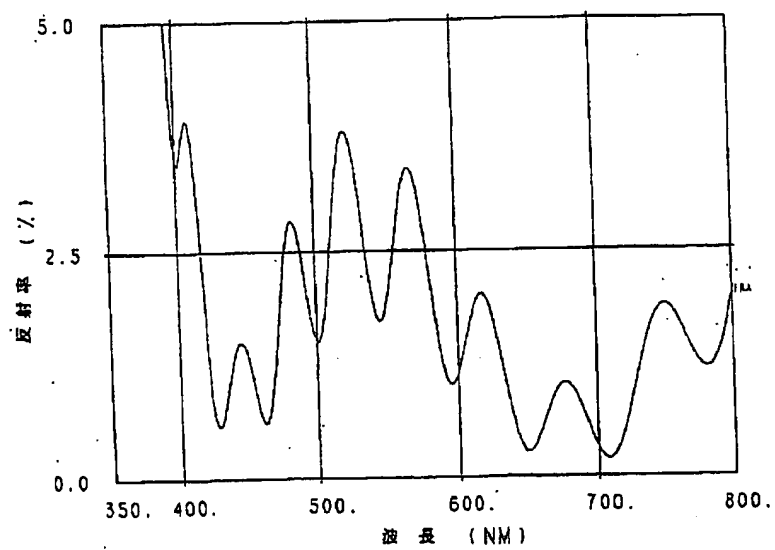
[Drawing 3]



[Drawing 4]



[Drawing 5]



[Translation done.]

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